Transportation Demand and Volume Sensitivity:

A Study of Grain Shippers in the Upper Mississippi River Valley

by

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Navigation and Economics Technology Program

A group of academic and non-academic economists, planners, etc. working with the Army Corps of Engineers to develop the economics underlying benefit measurement of investments in the waterways. Program is directed by Keith Hofseth of the Institute for Water Resources. Studies involve both base line studies as well as planning tools. Topics include:

- Choice modeling
- Spatial Equilibrium
- Spatial Econometrics
- Congestion modeling
- Port Efficiency
- Port Choice
- Forecasting transportation traffic.

All research on

www.corpsnets.us and there is a link to a monthly newsletter called

Nets News please sign up.

This is one paper in a series that examines the responsiveness of transportation demands to key determinants.

Background

- Transportation demand decisions commonly involve decisions with regard to:
  - Mode
  - Destination/Origin
  - Volumes Shipped

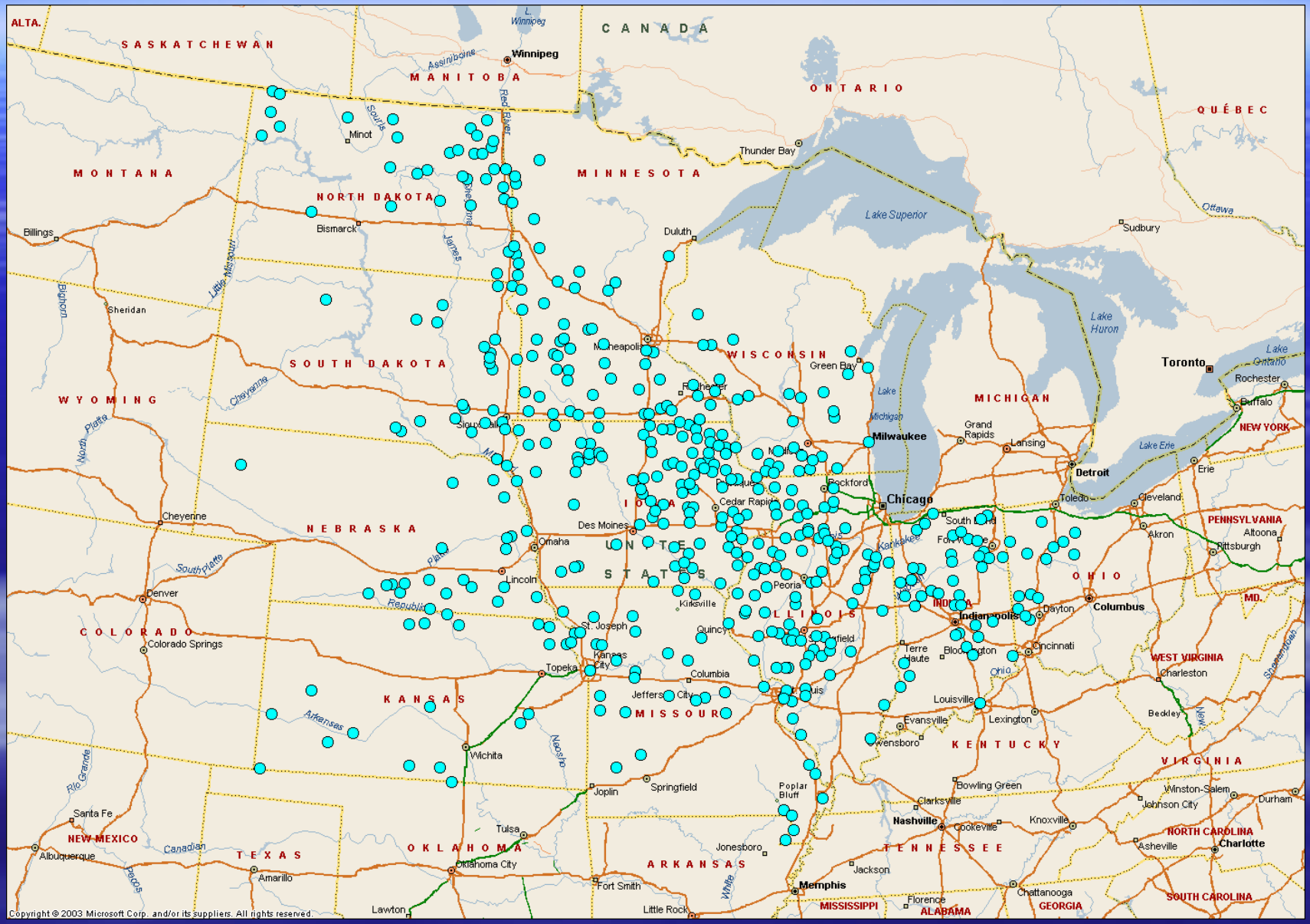
Background

- Analysis focuses on the annual shipment volumes of shippers and how these volumes adjust in response to changes in
  - Rates
  - Transit times
  - Reliability
- But, shipper attributes may also matter e.g., modal access, capacity, distances to alternative modes

Survey

- Implemented by Washington State University Social and Economic Sciences Research Center.
- States: Iowa, Illinois, Indiana, Wisconsin, Kansas, Missouri, Nebraska, North Dakota, South Dakota, Ohio, and Minnesota
- List of shippers from Dunn & Bradstreet, FarmNet Services, and NDSU list of warehouses/grain elevators
- Stratified sampling: > or < 100 miles to river
- August – October 2006.
- 480 responses, with 27.5% response rate.

Shipper Locations



Destination locations

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Mode Access

Mode	Yes	No	Mean Distance to Mode if No Direct Access (miles)	Median Distance to Mode if No Direct Access (miles)	N
Truck	479	1	N.A.	N.A	
Rail	201	270	25	20	248
Barge	23	435	137	90	390

Longevity at location

Years	Frequency	%	Cumulative %
10	17	3.74	3.74
20	33	7.25	10.99
30	59	12.97	23.96
40	61	13.41	37.36
50	66	14.51	51.87
60	39	8.57	60.44
70	27	5.93	66.37
80	30	6.59	72.97
90	45	9.89	82.86
100	56	12.31	95.16
110	15	3.3	98.46
120	2	0.44	98.9
130	3	0.66	99.56
140	1	0.22	99.78
150	1	0.22	100
Total	455	100	

Response of annual volumes to changes in average rates, times, and reliability

- Shippers were asked if the average rates they faced rose by X%, would they reduce their annual volume shipped, and if so by how much.
- Asked for: rate to shipper alone, rate to all shippers, transit time, and reliability

Response to rate increases to all shippers

% Rate Change	Change	No Change	% Change given a Change Occurs	Implied Elasticity given a Change Occurs
10	8	48	15.8	1.58
20	23	56	23.3	1.17
30	17	48	32.8	1.09
40	37	38	30.6	0.77
50	38	44	38	0.76
60	39	33	42.6	0.71
Total	162	267	41.8	0.88

Response to rate increases to shipper alone

% Rate Change	Change	No Change	% Change given a Change Occurs	Implied Elasticity given a Change Occurs
10	29	49	31.25	3.13
20	42	28	35.46	1.77
30	41	39	35.18	1.17
40	49	26	52.08	1.30
50	56	15	55.02	1.10
60	34	12	61.85	1.03
Total	251	169	46.44	1.48

Response to time increases

% Time Change	Change	No Change	% Change Given a Change Occurs	Implied Elasticity given a Change Occurs
10	14	66	15.25	1.53
20	15	61	19.14	0.96
30	21	35	31.06	1.04
40	28	40	29.91	0.75
50	27	32	37.25	0.75
60	39	41	39.73	0.66
Total	144	275	31.57	0.86

Response to reliability decreases

% Reliability Change	Change	No Change	% Change given a Change Occurs	Implied Elasticity given a Change Occurs
10	12	57	16.25	1.63
20	21	46	21.92	1.10
30	26	44	27.13	0.90
40	26	37	29.25	0.73
50	29	45	33.46	0.67
60	28	35	32.57	0.54
Total	142	264	28.19	0.84

Stated preference questions related to annual shipment volumes:

If rates increased by XX percent, would your annual shipment volumes decrease?

If yes, by what percent?

Possible responses:

- No
- Yes and the percentage of decrease.

Model components

- As a matter of theory, we can illustrate that the sp questions can be modeled from a wide range of alternative models. Empirically, we have two parts:
  - Probit model of whether shipper reduces its annual volume
  - Regression of amount of reduction, given a reduction occurs corrected for the probability that a reduction may not occur.

Model for volume response to rate changes to all shippers

	(1)		(2)		(3)	
Variable	**Level**	**Selection**	**Level**	**Selection**	**Level**	**Selection**
Log (1+rate change)	-1.380		-0.864		-0.901	
	(5.41)***		(2.71)***		(2.82)***	
Log (rate change)		0.502		0.616		0.706
		(4.93)***		(4.89)***		(5.31)***
Access Barge				0.305		0.067
				(0.54)		(0.12)
Access Rail				0.162		0.077
				(1.14)		(0.25)
Access Barge and Rail				1.345		0.903

continued

Log(Storage Capacity)						-0.149
						(2.15)**
Log(Rail Car Loading cap)						0.211
						(2.50)**
Log(Distance to Rail)						0.169
						(2.11)**
Number of Options					0.064	
					(2.09)**	
Constant	0.579	0.131	-0.202	0.173	-0.306	1.290
	(6.16)***	(0.99)	(1.12)	(1.05)	(1.66)*	(1.80)*
Observations	404	404	404	404	370	370

Elasticities wrt Rate Change for all shippers

Percentage Change in Rates	Conditional Elasticity	Unconditional Elasticity	Probability of a Volume Change
10	-1.407	-0.075	0.050
20	-1.116	-0.153	0.123
30	-0.954	-0.208	0.191
40	-0.845	-0.246	0.251
50	-0.764	-0.272	0.304
60	-0.700	-0.289	0.350

Model for volume response to rate changes to shipper alone

	(1)		(3)		(5)	
Variable	**Level**	**Selection**	**Level**	**Selection**	**Level**	**Selection**
Log (1+rate change)	-1.995		-2.275		-1.760	
	(5.21)***		(6.31)***		(3.70)***	
Log (rate change)		0.493		0.530		0.573
		(4.91)***		(5.55)***		(4.47)***
Access Barge				-0.031		1.026
				(0.15)		(1.52)
Access Rail				0.097		-0.134
				(1.50)		(0.45)
Access Barge and						

continued

Log(Storage Capacity)						-0.141
						(1.99)**
Log(Rail Car Loading Capacity)						0.191
						(2.36)**
Log(Distance to Rail)						-0.009
						(0.12)
Number of Options					-0.037	
					(0.92)	
Constant	0.493	0.604	0.564	0.607	-0.027	1.962
	(4.03)***	(4.04)***	(4.77)***	(4.27)***	(0.09)	(2.62)***
Observations	340	340	340	340	309	309

Elasticities wrt Rate Change for shipper alone

Percentage Change in Rates	Conditional Elasticity	Unconditional Elasticity	Probability of a Volume Change
10	-2.709	-0.657	0.215
20	-1.840	-0.737	0.347
30	-1.493	-0.761	0.436
40	-1.284	-0.759	0.502
50	-1.136	-0.742	0.553
60	-1.023	-0.719	0.594

Model for volume response to time changes

	(1)		(3)		(5)	
Variable	**Level**	**Selection**	**Level**	**Selection**	**Level**	**Selection**
Log(1+time change)	-0.955		-0.937		-1.082	
	(2.41)**		(2.54)**		(2.31)**	
Log(time change)		0.483		0.494		0.479
		(4.20)***		(4.27)***		(3.96)***
Access Barge				-0.558		-0.480
				(0.88)		(0.75)
Access Rail				0.009		-0.378
				(0.06)		(1.28)
Access Barge and						

continued

Log(Storage Capacity)						0.049
						(0.71)
Log(Rail Car Loading Capacity)						0.085
						(1.06)
Log(Distance to Rail)						-0.034
						(0.45)
Number of Options					0.016	
					(0.56)	
Constant	-0.161	0.007	-0.180	0.036	0.038	-0.376
	(0.50)	(0.05)	(0.63)	(0.21)	(0.09)	(0.53)
Observations	383	383	383	383	352	352

Elasticities wrt Time Change

Percentage Change in Rates	Conditional Elasticity	Unconditional Elasticity	Probability of a Volume Change
10	-1.841	-0.310	0.155
20	-1.179	-0.321	0.247
30	-0.960	-0.335	0.312
40	-0.839	-0.344	0.362
50	-0.756	-0.348	0.403
60	-0.694	-0.349	0.437

Model for volume response to reliability changes

	(1)		(3)		(5)	
Variable	**Level**	**Select**	**Level**	**Select**	**Level**	**Select**
Log(1+rel. change)	-0.526		-0.719		-0.644	
	(2.26)***		(3.58)***		(3.00)***	
Log (rel. change)		0.391		0.285		0.215
		(3.35)***		(2.68)***		(1.91)*
Access Barge				-0.119		-0.038
				(0.54)		(0.17)
Access Rail				0.135		-0.189
				(2.01)**		(1.18)
Access Barge						

continued

Log(Storage Capacity)						0.030
						(0.75)
Log(Rail Car Loading Capacity)						0.054
						(1.53)
Log(Dist. to Rail)						-0.048
						(1.07)
Number of Options	-0.229	-0.063	0.310	-0.234	0.292	-0.493
	(1.14)	(0.42)	(4.28)***	(1.59)	(3.52)***	(1.15)
Constant					-0.004	
					(0.32)	
Observations	377	377	377	377	348	348

Elasticities wrt Reliability Change

Percentage Change in Rates	Conditional Elasticity	Unconditional Elasticity	Probability of a Volume Change
10	2.417	0.619	0.231
20	1.259	0.388	0.279
30	0.906	0.311	0.309
40	0.735	0.272	0.331
50	0.632	0.248	0.348
60	0.561	0.231	0.363

Conclusions

- Shippers do respond to rates, transit time, and reliability.
- Shippers respond by adjusting their annual volumes.
- A large share of shippers have no feasible alternatives to their chosen mode/destination.
- Elasticities wrt rates, times, and reliability are generally small.

Conclusions, cont'd

- Shippers adjust their annual volumes more in response to a rate change to the shipper alone than to a rate change to all shippers.